NON-PUBLIC?: N
ACCESSION #: 9108190093
LICENSEE EVENT REPORT (LER)

FACILITY NAME: McGuire Nuclear Station, Unit 2 PAGE: 1 OF 10

DOCKET NUMBER: 05000370

TITLE: A Manual Unit 2 Reactor Trip Was Initiated Due To A Control Rod Failure Caused By An Equipment Failure
EVENT DATE: 7/14/91 LER #: 91-07-0 REPORT DATE: 8/13/91

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 90.5%

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Alan R. Sipe, Chairman, TELEPHONE: (704) 875-4183
McGuire Safety Review Group

COMPONENT FAILURE DESCRIPTION:
CAUSE: AW SYSTEM: RBK COMPONENT: IWPSUP MANUFACTURER: W120
REPORTABLE NPRDS: Yes

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On July 12, 1991, operations (OPS) personnel and Instrumentation and Electrical (IAE) personnel were performing the quarterly calibration on Power Range Neutron Flux Channels for Unit 2 to correspond with current Incore/Excore Correlation values. During this calibration, a Quadrant Power Tilt Ratio (QPTR) alarm was received after the first Neutron Flux Channel was returned to service. To comply with Technical Specifications (TSs), a load reduction to 91 percent power was required. During the subsequent power reduction, Group 1 of Control Rod Bank D failed to move properly causing a Control Rod misalignment greater than TS limits. To comply with TSs, Boron was added and the Control Rods were realigned. An Axial Flux Difference (AFD) oscillation resulted from the movement of the Control Rods and power reduction. Since the Control Rods would not move properly they were unavailable to dampen the oscillation. IAE personnel attempted to repair the Control Rod problem during the next day, but were

unable to do so. At 0658, on July 14, 1991, OPS personnel initiated a manual Reactor Trip prior to exceeding Ts limits for AFD. OPS personnel implemented the Reactor Trip recovery procedure to recover from the transient. Unit 2 was in Mode 1 (Power Operation) at 90.5 percent power at the time of the Reactor Trip. This event is assigned a cause of Equipment Failure because the Control Rods would not properly insert into the core. Subsequent repairs were made to correct the problem and the Unit returned to Power Operation on July 16, 1991, at 0608.

END OF ABSTRACT

EVALUATION:

Background

The Full Length Rod control System EIIS:AA! is used for Reactor EIIS:RCT! Control, Startup, and Shutdown to compensate for short term reactivity changes. Every 31 days, each Control Rod EIIS:ROD! Drive Bank is determined operable by movement of at least 10 steps in any one direction. This operability determination is accomplished by procedures PT/1 and 2/A/4600/01, Rod Cluster Control Assembly (RCCA) Movement Test.

Each RCCA has a Digital Rod Position Indicator (DRPI) channel EIIS:CHA! which displays the position of the Control Rod. Movements of each bank of rods can be made manually as necessary and monitored, using the DRPI and Rod Step Demand Counter positions displayed in the Control Room EIIS:NA!. The Rod Step Demand Counter indicates the demand position which has been entered by OPS personnel to the Rod Control System.

Description of Event

On July 12, 1991, at 2030, Operations (OPS) Shift personnel reduced load on Unit 2 to 95 percent Reactor power to support the quarterly calibration of the Power Range Neutron Flux Channels. This calibration is performed to calibrate the Power Range Channels to correlate excore offset to incore measured offset. The data used to calibrate the Power Range Channels is supplied by Performance (PRF) Reactor Group personnel.

Instrumentation and Electrical (IAE) personnel completed the calibration of Power Range Channel N41, at 0150, on July 13, 1991. When the channel was returned to service, OPS Control Room personnel received a Quadrant Power Tilt Ratio (QPTR) alarm EIIS:ALM!. This was because new calibration values had been inserted for Channel N41 and had not yet been inserted for the 3 remaining Power Range Channels. Even though this

alarm was generated because of the incomplete calibration, OPS personnel conservatively interpreted Technical Specification (TS) 3.2.4 (Quadrant Power Tilt Ratio) to require that Reactor power be reduced by 3 percent from "Rated Thermal Power" for each 1 percent of indicated QPTR in excess of 1.0. Therefore, at 0254, OPS personnel began a Reactor power decrease to 91 percent to comply with the TS.

During the reduction in power, OPS personnel determined that Control Rod Bank D Group 1 Rods failed to move as required and the rods became misaligned by 18 steps. The load reduction was halted. OPS personnel referenced procedure AP/2/A/5500/014, Rod Control Malfunctions (Case 4). However, this procedure does not specifically address this situation and was used as a guide. Subsequently, OPS personnel added Boron and realigned Bank D Rods.in compliance with TS 3.1.3.1, Moveable Control assemblies. TS 3.1.3.1 states that all Control Rods shall be positioned within +/- 12 steps (indicated position) of their group Rod Step Demand Counter

position. At 0340, the Control Rods in Bank D were realigned at 216 steps. At this time, an Axial Flux Difference (AFD) oscillation started because of the movement of the Control. Rods and power decrease. Reactor power was now at 91.5 percent. During the time after the rod misalignment occurred, the PRF Reactor Group Duty Engineer had been informed of the QPTR problem and the rod misalignment. The PRF Reactor Group Duty Engineer in turn called the PRF Reactor Group Supervisor. They discussed the situation and the TS action statement for realignment of the rods. Their concern at this time was that once the rods were back within TS limits for alignment, a maximum movement of 3 steps/hr be maintained for fuel integrity. Some QPTR tilt is expected by the Reactor Group when only one Power Range Channel has been recalibrated to new Incore/Excore current values.

At 0408, OPS personnel made notification to the NRC of the QPTR and Rod Control problems. The Station Manager, OPS Unit Manager, and IAE personnel were also informed. Appropriate IAE personnel were called to investigate the Rod Control problems.

At 0605, IAE personnel replaced the Master Cycler Selector Card in the Logic Cabinet EIIS:CAB! of the Rod Control System. OPS personnel then attempted to move Bank D Control Rods. Control Rods in Bank D Groups 1 and 2 moved in but Group 1 failed to move back out properly. OPS personnel then returned Bank D Group 2 Control Rods to 208 steps while Group 1 lift coils EIIS:CL! were disconnected. This realigned both groups of Control Rods once again.

At approximately 0730, the PRF Reactor Group Duty Engineer and the Maintenance Engineering Support (MES) person with system expertise on the Rod Control System arrived on site. At approximately 0800, appropriate personnel from OPS, PRF, IAE, MES, and Integrated Scheduling (IS) met to discuss the problems and proper course of action. At this time, all parties involved felt that the AFD oscillation was convergent and would not exceed TS limits. They also had determined that the Rod Control problem was electrical in nature rather than mechanical and that the Control Rods would insert properly on a Reactor Trip. Since the Control Rods in Bank D Group 1 had moved in with no problem, it was felt at this time that the problem was in moving the Control Rods in Bank D Group 1 in the outward direction. Therefore, to prevent further aggravation of the AFD oscillation and maintain fuel integrity, troubleshooting was limited to attempting to move only Bank D Group 1 Control Rods in the out direction a maximum of 5 steps. PRF Reactor Engineering personnel had consulted with Design Engineering personnel to determine that this movement would not be detrimental to fuel integrity. Design Engineering personnel stated that the movement was safe because of the position of the Control Rods at that time.

At 0943, IAE personnel returned Power Range Neutron Flux Channel N41 calibration values to the original (as found) values. This resolved the QPTR problem.

IAE
nd MES personnel continued troubleshooting and a number of attempts were made to move

Bank D Group 1 control Rods outward with no success. During the course of the day, IAE and MES personnel noted that temperature in the area of the Rod Control Cabinets was rising. This was because of Nuclear Station Modification (NSM) MG-52298, then in progress, requiring access to the area by large double doors (EIIS:DR! from the Turbine Building EIIS:NM!. Personnel performing the NSM had propped the doors partially open to provide access for cables, welding leads, and hoses. The doors were subsequently closed and the cables, welding leads, and hoses rerouted at approximately 1800. This stabilized the temperature as much as possible in the room but effects of the increased temperature were still present causing multiple and changing problems in the Rod Control System.

Also, at approximately 1800, the PRF Reactor Group Duty Engineer left the site. ops personnel in the Control Room continued to monitor the AFD oscillation and the PRF Reactor Group Engineer was to continue to monitor

it through the evening to ensure that the oscillation was remaining as expected using his home computer. He believed the oscillation was convergent and that Bank D Groups 1 and 2 Control Rods would move in the inward direction if required. He was later unable to receive data on his home computer because of an equipment problem with his computer. He did, however, continue to check periodically with OPS personnel via phone.

At 2115, IAE and MES personnel decided to leave the site since no progress was being made to repair the problem and no relief personnel could be obtained to continue the troubleshooting process. Their plans were to return at 0800 on the next morning when they were rested. However, the MES person continued from home to try and call in qualified personnel to continue the troubleshooting until approximately 2315. The OPS Unit Manager, Shift Manager, and PRF Reactor Group Duty Engineer all believed that the Bank D Control Rods would move in and that delaying the troubleshooting until the next day would have no serious consequences on the Unit since they also believed the oscillation to be convergent.

At 2200, the AFD oscillation reached the most negative value of -17 percent (-14 from target). This was within the specified negative TS limit of -23 percent and all personnel involved expected the peaks to converge; therefore, remaining well within TS limits.

At approximately 0500, on July 14, 1991, OPS Shift personnel determined that the AFD was headed toward the positive TS limit at a rapid rate. The PRF Reactor Group Duty Engineer was notified. The PRF Reactor Group Supervisor recommended tripping the Unit prior to exceeding the positive TS limit.

At 0630, the OPS Shift personnel notified the OPS Unit Manager of the decision to trip the Unit. OPS personnel attempted to move Bank D Control Rods in. Neither group would move at this time. The MES person involved was consulted and determined that no action could be taken at that time to resolve the Rod Control problem.

The AFD was now at +11.8 percent and increasing toward the positive TS limit of +12 percent. At 0658, OPS Shift personnel manually tripped the Reactor prior to reaching the TS limit. OPS personnel then implemented procedures EP/2/A/5000/001, Reactor Trip Or Safety Injection, EP/2/A/5000/1.3, Reactor Trip, and OP/2/A/6100/005, Unit Fast Recovery, to recover from transient. Following the trip, all systems functioned as designed. OPS personnel also made the required notification to the NRC of an Unusual Event. At 0720, OPS personnel terminated the Notification of Unusual Event. Subsequently, IAE personnel replaced a firing card in

Group A of Power Cabinet 1BD for Bank B Group 1 Control Rods. This enabled Bank D Group 1. Control Rods to move properly. All Control Rod Groups were then verified to move properly.

Conclusion

This event is assigned a cause of Equipment Failure because the Control Rods in Group 1 of Bank D would not move properly. Since the Control Rods would not move on demand, they were not available to dampen the AFD oscillation once it started.

It would have been possible to reduce Reactor power to less than 50 percent early in the event on July 13. This would have released the Unit from the constraints as specified by TS on AFD and QPTR. However, after discussion of the situation, all parties involved (OPS, PRF Reactor Group, MES, IS, and IAE) felt that the AFD oscillation would be convergent and would not exceed TS limits or endanger the Reactor Core.

This decision was based on past experience since oscillations had not been known to be divergent in the past. No models of AFD oscillations had ever been run to show that an AFD oscillation would be divergent during normal operating conditions at McGuire. Also, the McGuire Final Safety Analysis Report (FSAR) section 4.3.1.6 states the following:

"The core is designed so that diametral and azimuthal Oscillations due to spatial xenon effects are self-damping and no operator action or control action is required to suppress them. The stability to diametral oscillations is so great that this excitation is highly improbable. Convergent azimuthal oscillations can be excited by prohibited motion of individual control rods. Such oscillations are readily observable and alarmed, using the excore long ion chambers. Indications are also continuously available from incore thermocouples and loop temperature measurements. Moveable incore detectors can be activated to provide more detailed information. In all cores, these horizontal plane oscillations are self-damping by virtue of reactivity feedback effects designed into the core. However, axial xenon spatial power oscillations may occur late in core life. The control bank and excore detectors are provided for control and monitoring of axial power distributions. Assurance that fuel design limits are not exceeded is provided by Reactor Overpower Delta T and Overtemperature Delta T trip functions which use the measured axial power imbalance as an input."

Based on all the information available to them at the time, personnel

involved felt that the beet course of action was to remain at the current power level (90.5 percent) and continue the troubleshooting process on the Rod Control System. The AFD oscillation was monitored throughout the event by OPS and PRF Reactor Engineering personnel to ensure that it remained within safe limits. At no time were Reactor Core thermal limits violated during the event. All troubleshooting activities were limited to Bank D Group 1 Control Rods in the outward direction. These attempts to move Bank D Group 1 Control Rods were also limited to 5 steps. This reduced the possibility of aggravating the AFD oscillation and insured integrity of the fuel was maintained. All management personnel involved believed that the Control Rods would have moved in if required. MES and IAE personnel stated that when they left for the night, test equipment measurements indicated that the Control Rods would move in if required. There was some discrepancy in communications at this point because the OPS Control Room personnel did not receive communication from MES and IAE personnel performing the troubleshooting. The OPS Control Room personnel stated that they did not believe that any Control Rods in Bank D would move at all when the IAE and MES personnel left for the night on July 13. Even though they did not believe the Control Rods would move, no power maneuvers requiring rod movement were anticipated and the Control Rods were known to be trippable. They also stated that they believed the oscillations were convergent and would not exceed TS limits. They also knew they could adjust Boron concentration to correct reactivity changes if necessary or the Unit could be tripped if required. OPS personnel quickly determined that the AFD oscillation was going to exceed the positive TS limit on July 14, 1991. All personnel consulted recommended the Unit be manually tripped. OPS personnel manually tripped the Unit prior to reaching TS limits.

OPS personnel responded to the transient in a timely manner to stabilize the Unit. All equipment and systems operated within specifications and functioned as expected during the trip. IAE personnel replaced a firing card in the Power Cabinet for Bank B Group 1 Control Rods and repaired the problem. All Control Rod Banks were subsequently verified to operate properly. Further analysis of why the Control Rod problem occurred will continue during the next Refueling Outage for Unit 2. Project Services personnel are evaluating the entrances into the room housing the Rod Control Cabinets to determine if further sealing is required to prevent added heat load to the room. The FSAR section 4.3.1.6 will be revised to reflect the fact that if no actions are taken to suppress them, axial AFD oscillations due to spatial xenon effects, may not be self-damping. Also, this information will be factored into the Reactivity Management Program currently under development at all three nuclear stations.

A review of the Operating Experience Program Data Base for the 24 months prior to this event revealed 10 previous events involving a Reactor Trip

in which the root cause was equipment failure or possible equipment failure. The previous events were documented in LERs 369/89-22, 369/89-29, 369/90-01, 370/90-06, 369/90-11, 369/90-27, 369/90-32, 370/90-08, 369/91-01, and 369/91-04. LER 370/90-08 also involved a failure of the Rod Control System; therefore, this problem is considered recurring. However, the previous LER involved Shutdown Bank E

falling into the core for unknown reasons and the cause was never found. Therefore, no corrective actions for LER 370/90-08 could have prevented this event from occurring.

This event is Nuclear Plant Reliability Data System (NPRDS) reportable.

There were no personnel injuries, radiation overexposures, or uncontrolled releases of radioactive material as a result of this event.

CORRECTIVE ACTIONS:

Immediate: 1) OPS personnel implemented the Reactor Trip and Unit Fast Recovery Procedures.

Subsequent: 1) IAE personnel replaced a firing card in the Power Cabinet for Bank B Group 1 Control Rods.

2) IAE and OPS personnel, in conjunction with troubleshooting, verified that all Control Rod Banks would move properly.

Planned: 1) IAE and MES personnel will continue analysis of the Rod Control System and verify proper operation during the next Refueling Outage.

2) OPS personnel will evaluate and revise as necessary procedures AP/1&2/A/5500/14, Rod Control Malfunction, to better address situations as encountered in this event.

3) OPS Management personnel will cover this event with all licensed OPS personnel.

4) General Office Regulatory Compliance personnel, in conjunction with Design . Engineering Nuclear Design Group personnel, will initiate a request for a change to the FSAR section 4.3.1.6 to ensure that

appropriate data now known about AFD oscillation is
incorporated.

5) Compliance personnel, in conjunction with OPS personnel, will pursue an interpretation of TS 3.2.4, Quadrant Power Tilt Ratio, to allow operation during calibration of the Power Range Neutron Flux Instruments without a required power reduction if a QPTR alarm is received.

SAFETY ANALYSIS:

The Reactor was tripped manually as a result of an AFD oscillation which was recognized to be heading to a point outside of TS limits. At no time were TS limits for AFD exceeded and the initiating transient caused by the misalignment of the Control Rods is bounded by the "Rod Cluster Control Assembly Misoperation" event of the McGuire FSAR Accident Analysis, Chapter 15. At no time during the transient was the Reactor Core placed in jeopardy or in any way adversely affected. At no time were the Control Rods mechanically bound. They would have been able to safely trip and place the Reactor in a safe shutdown condition at any time during the event.

Following the Reactor Trip, OPS personnel followed normal Reactor Trip procedures. No abnormalities were noted and all primary and secondary systems operated within specifications. No safety systems were challenged. Emergency core cooling and emergency electrical power were available but not required and not actuated. There were no radiological consequences as a result of this event.

The health and safety of the public were not affected as a result of this event.

ADDITIONAL INFORMATION:

Sequence Of Events:

TR - Reactor Trip Investigation Report
SRO - Senior Reactor Operator's Logbook, Unit 2
RO - Reactor Operator's Logbook, Unit 2
SM - Shift Manager's Logbook, Unit 2
PR - Personnel Recollection

Date Time Event

07/12/91 2030 OPS personnel began load reduction to 95 percent power for calibration of Power Range Neutron Flux Channels on Unit 2. (SRO, RO)

2113 Load change was completed on Unit 2. (SRO,RO)

07/13/91 0150 IAE personnel completed calibration of Power Range Channel N41 and returned it to service. (SRO,PR)

OPS personnel received QPTR alarm when Channel N41 was returned to

service. (SRO,RO,SM)

0254 OPS personnel began a load decrease to 91 percent power to comply with TSB. (SRO,RO,SM)

0312 OPS personnel noted Control Rod Bank D Group 1 Control Rods failed to move. (RO,SM)

0340 OPS personnel added Boron and the Control Rods in Bank D were aligned in compliance with TS requirements. (SRO,SM)

AFD oscillation started. (TR)

Reactor Power was now at 92.5 percent. (SRO)

0402 Reactor Power was now at 91 percent. (SRO)

0408 NRC personnel, the Station Manager, the OPS Unit Manager, and appropriate IAE personnel were notified of the problem. (SRO,SM)

0605 IAE personnel replaced the Master Cycler Selector Card in the Logic Cabinet. (SRO)

OPS personnel attempted to move Bank D Control Rods. (SRO,SM)

Control Rods in Bank D Groups 1 and 2 moved in but Group 1 failed to move back out properly. (SRO,SM)

0705 OPS personnel returned Bank D Group 2 Control Rods to 208 steps to realign them with Group 1. (SRO)

0730 The PRF Reactor Group Duty Engineer and IAE MES person for the Rod Control System arrived on site. (PR)

0736 IAE personnel reduced the High Flux Trip setpoints to 100 percent - Reactor thermal power because of the QPTR problem. (SRO)

approx. 0800 OPS, PRF, IAE, MES, and IS personnel met to discuss the course of action for troubleshooting and set limits for Control Rod movement during troubleshooting. (PR)

0943 IAE personnel returned Channel N41 calibration values to their

original state. (SM)

IAE and MES personnel continued troubleshooting and a number of attempts were made to move Bank D Group 1 Control Rods with no success. (PR,SRO,RO)

1800 IAE and MES personnel, having noted a temperature rise in the area of control Rod Equipment Cabinets, closed the Equipment Room door to the Turbine Building. (PR)

The PRF Reactor Group Duty Engineer left the site. (PR).

OPS Shift personnel continued to monitor the AFD oscillation. (PR)

2115 IAE and MES personnel suspended troubleshooting with plans to return at 0800 the next morning. (SRO)

2200 The AFD oscillation reached the most negative value of -17 percent (-14 from target). (TR)

OPS Shift personnel continued to monitor the AFD

oscillation. (PR)

7/14/91 0500 OPS Shift personnel determined that the AFD oscillation was headed toward >TS limit of +12 percent. (PR)

PRF Reactor Group personnel were notified of the situation by OPS Shift personnel and recommended tripping the Unit. (PR)

0630 OPS Shift personnel notified the OPS Unit Manager of the decision to trip the Unit and he agreed. (PR)

OPS Shift personnel made a final attempt to move Bank D Control Rods in, but were unsuccessful. (PR)

0658 AFD value was now at +11.8 percent and increasing. (TR)

OPS Shift personnel manually tripped the Reactor and Turbine Generator prior to exceeding the TS limit. (SRO)

ATTACHMENT 1 TO 9108190093 PAGE 1 OF 1

Duke Power Company (704)875-4000
McGuire Nuclear Station
12700 Hagers Ferry Road
Huntersville, NC 28078-8985

DUKE POWER

August 13, 1991

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: McGuire Nuclear Station Unit 2
Docket No. 50-370
Licensee Event Report 370/91-07

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 370/91-07 concerning a Unit 2 manual Reactor Trip. This

report is being submitted in accordance with 10 CFR 50.73(a)(2)(iv). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

T. L. McConnell

ADJ/cbl

Attachment

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